

The environment of SMGs

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Key Question

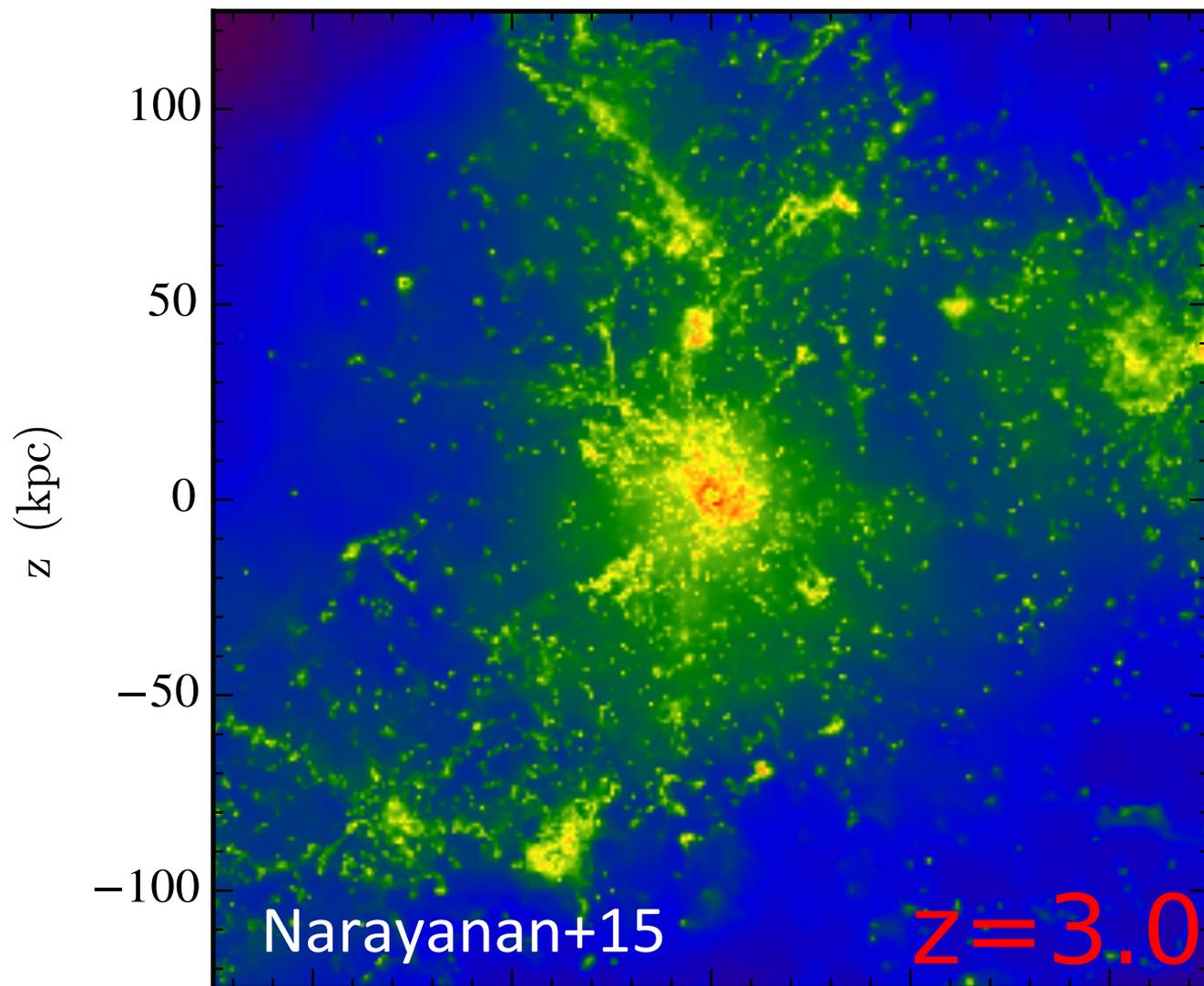
How do SMGs relate to Ly α emitting gaseous haloes (LABs) and protoclusters?

- ALMA observations of giant (>100 kpc) LABs in the SSA22 protocluster at $z=3.1$
- SCUBA-2 survey of HSC-selected $z=4$ protoclusters

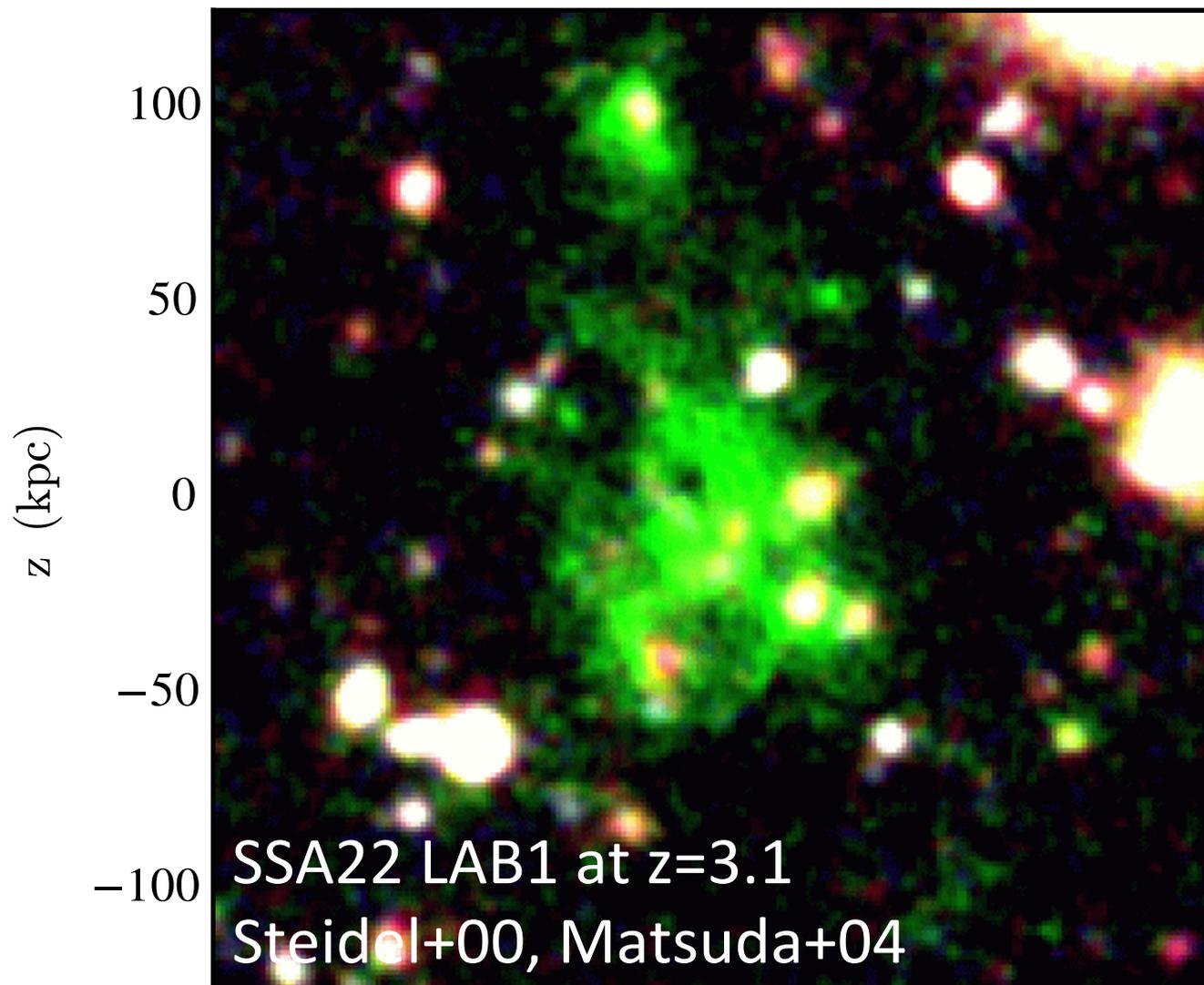
How do SMGs relate to LABs?

Talks by Chapman, Karim, Frayer and Casey
Posters by Dannerbauer and Ao

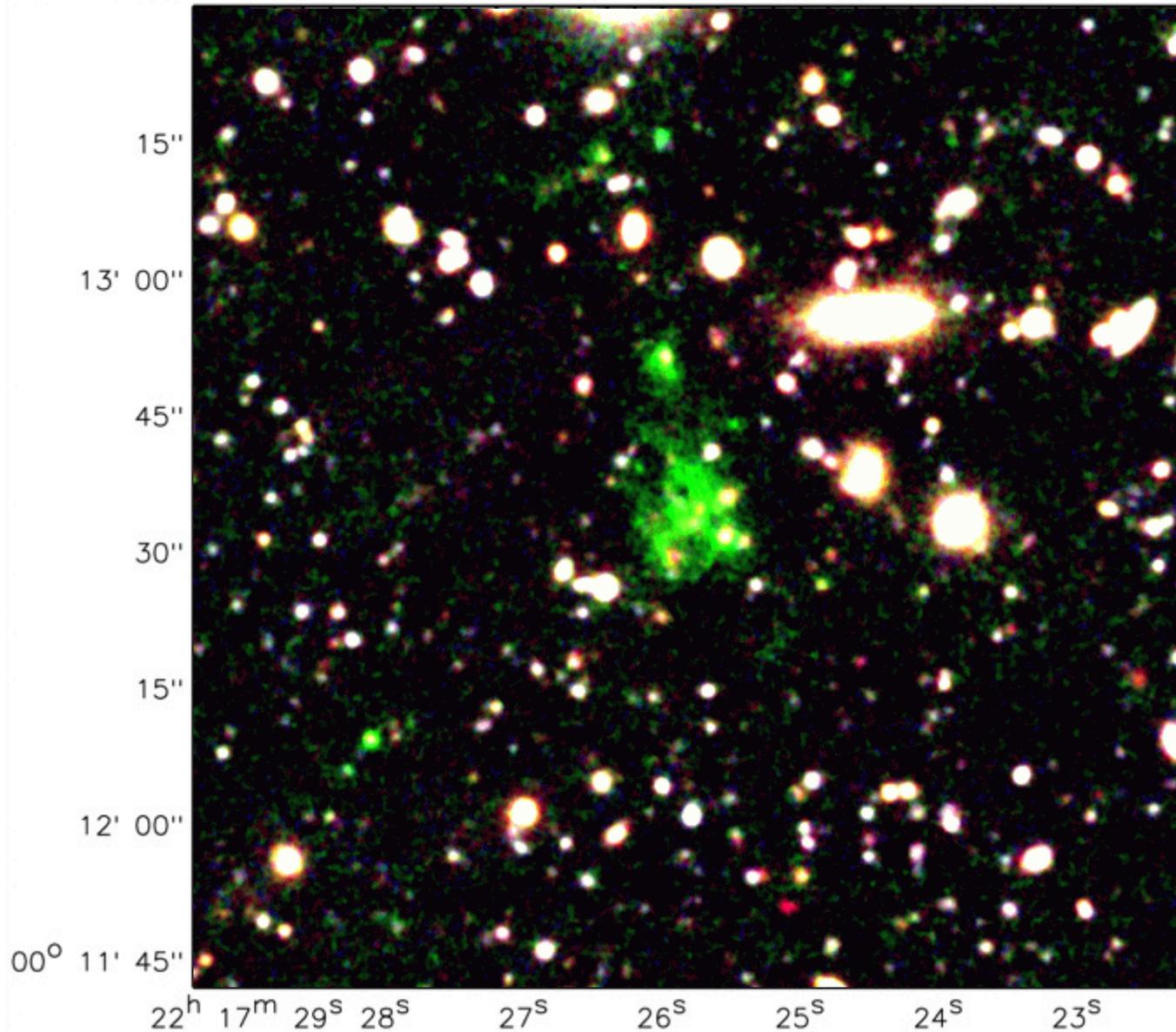
How is the ambient gas of real SMGs?



How is the ambient gas of real SMGs?



Strong connection between SMG and LAB



SSA22 LAB01
(Chapman+01, 04)

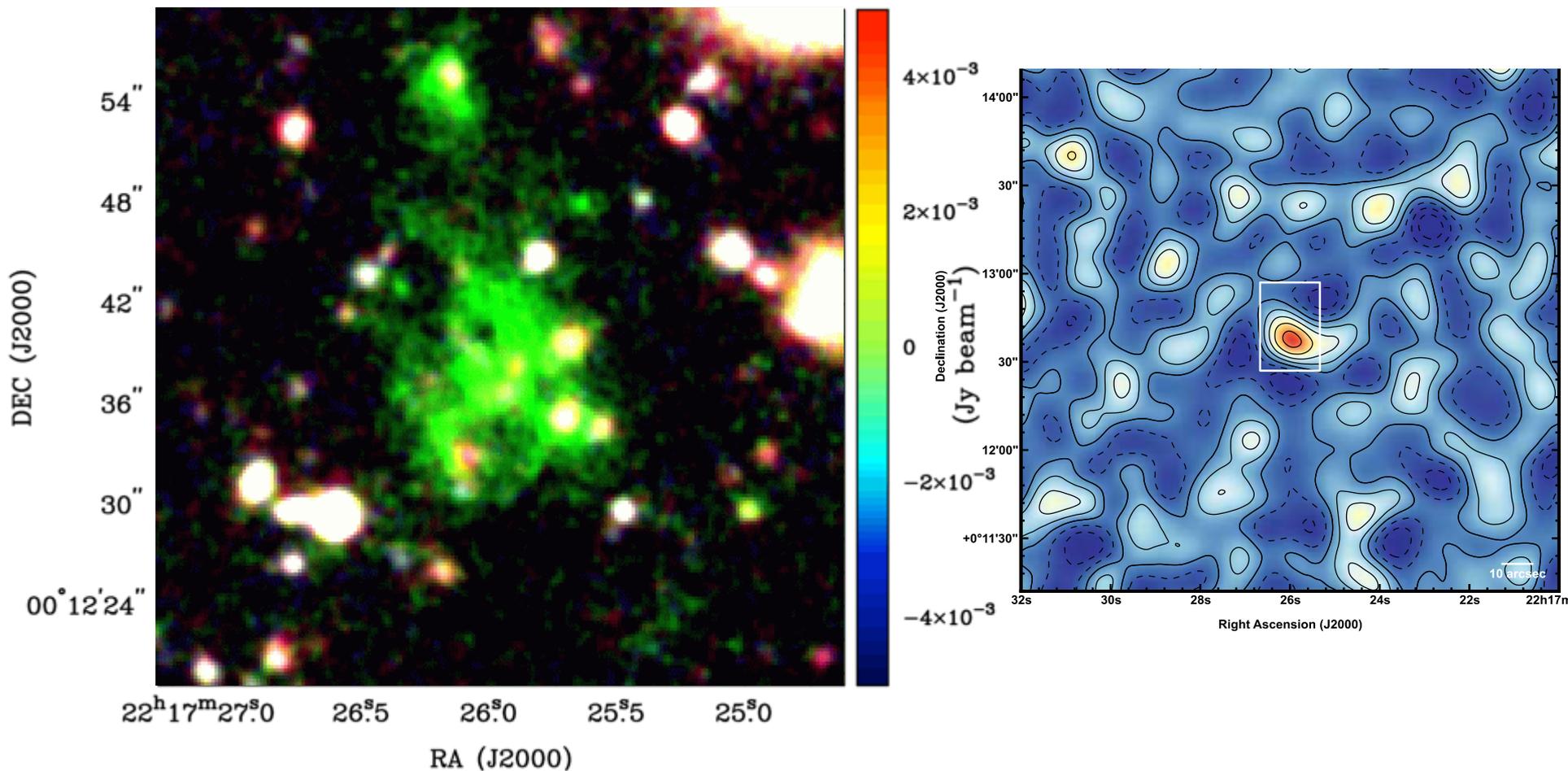
$S_{850}=17\text{mJy}$ source!!

One of the brightest
(un-lensed) SMGs.

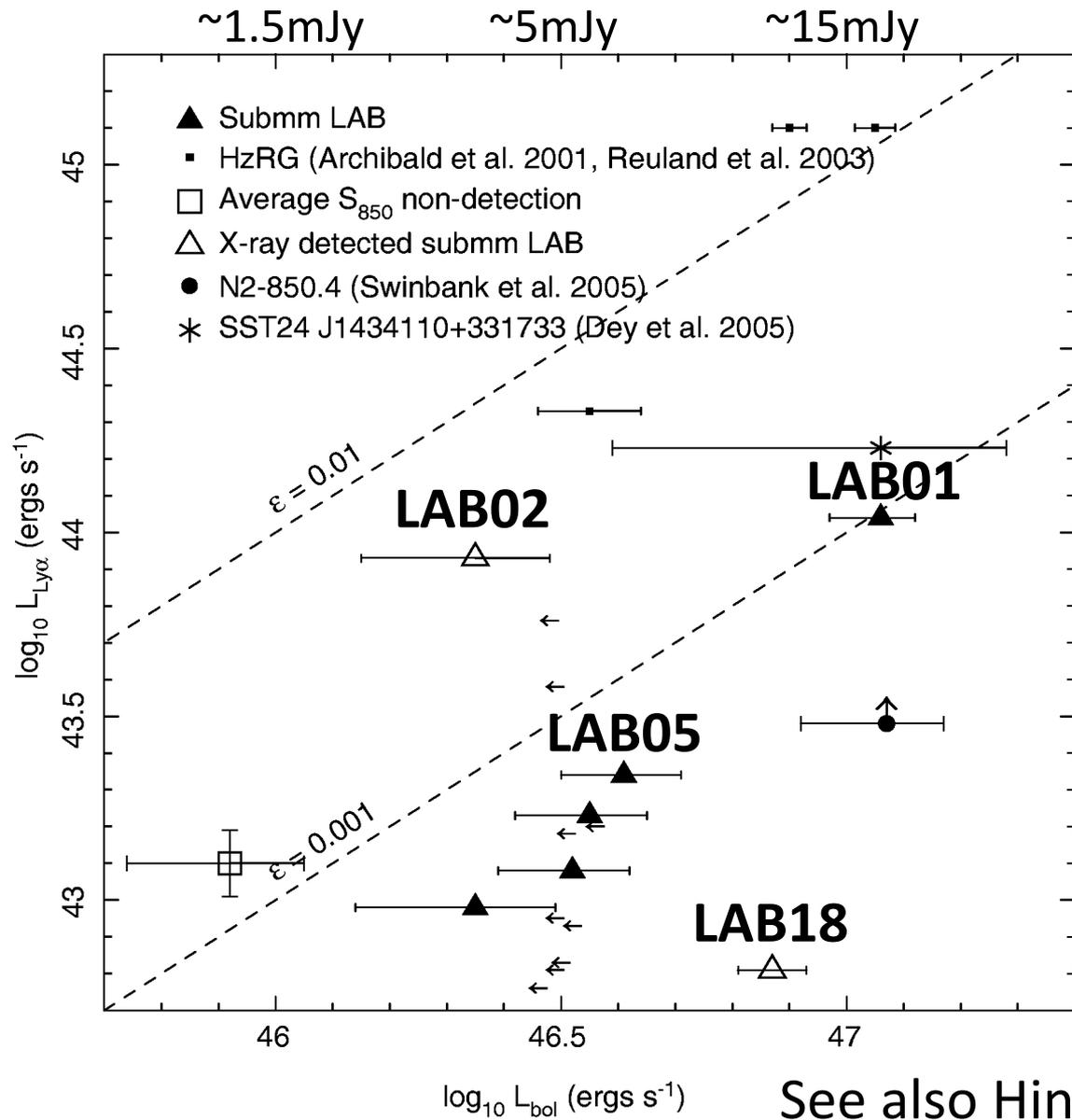
SMA / SCUBA-2 Observations

SMA map (Matsuda+07)
S880 < 4.2 mJy (3-sigma)

SCUBA-2 map (Geach+14)
S850 = 4.6 +/- 1.1 mJy



SCUBA 850um Observations

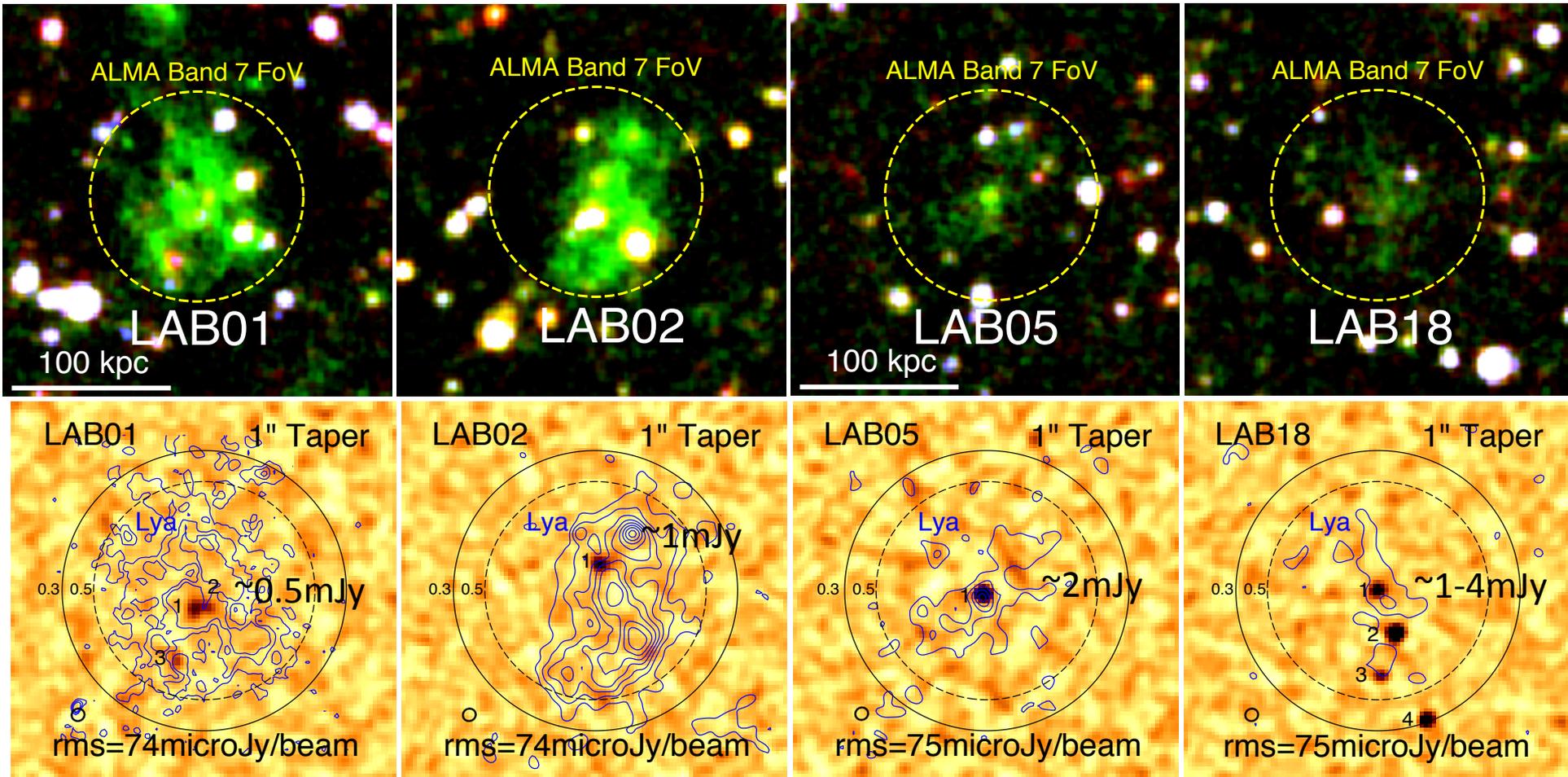


Geach+05

See also Hine+16 and Ao+17

ALMA 860um Observations

(w/ Kohno, Hatsukade, Ikarashi, Umehata, Ao, Kato, Smail, Geach, Hine, Chapman, Alexander, Steidel)

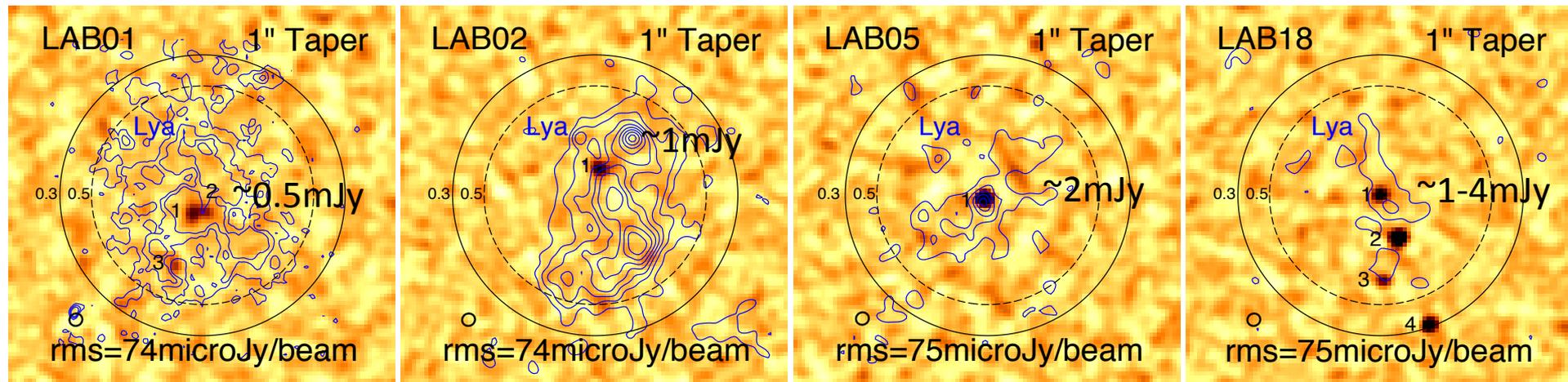


See also Ao's poster, Alexander+16, Geach+16 and Umehata+17

ALMA 860um Observations

(w/ Kohno, Hatsukade, Ikarashi, Umehata, Ao, Kato, Smail, Geach, Hine, Chapman, Alexander, Steidel)

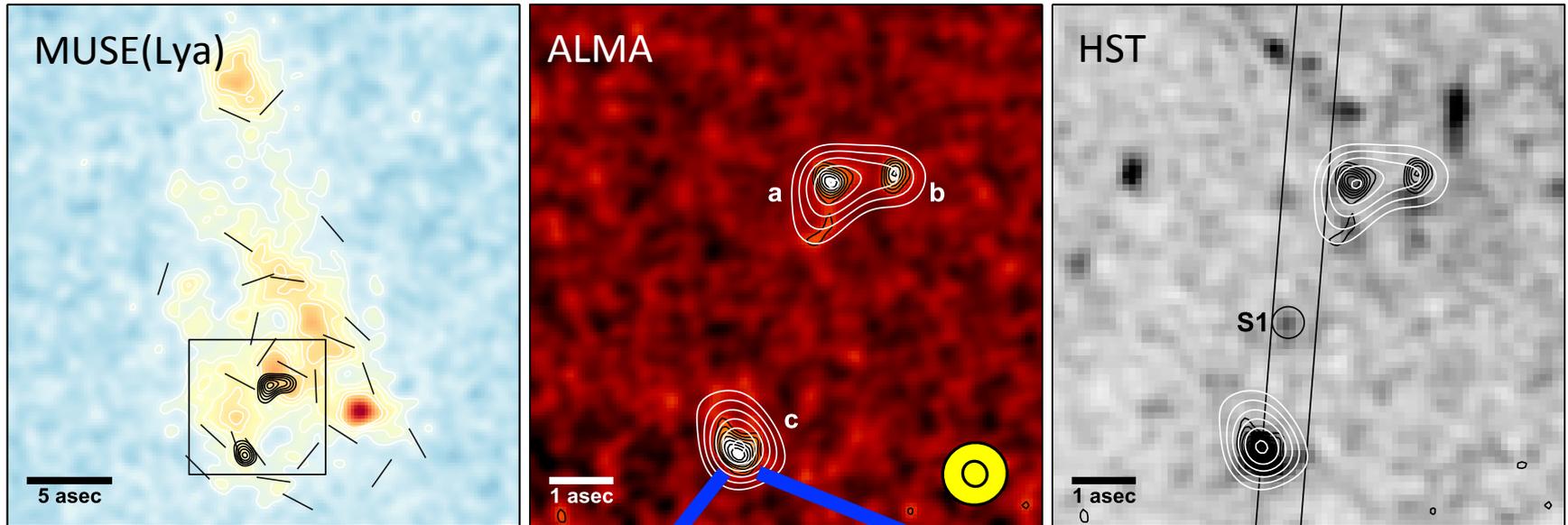
ALMA showed that all the observed 4 giant (>100 kpc) LABs consist of single or multiple SMGs.



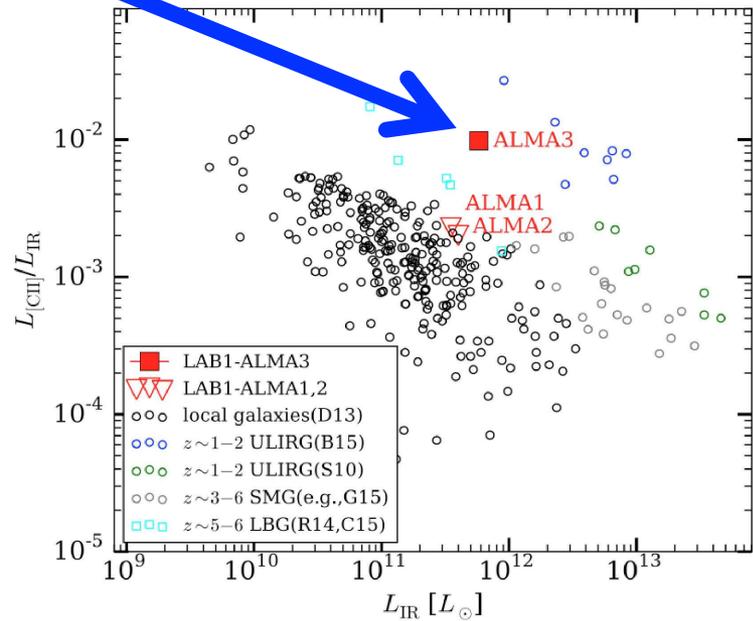
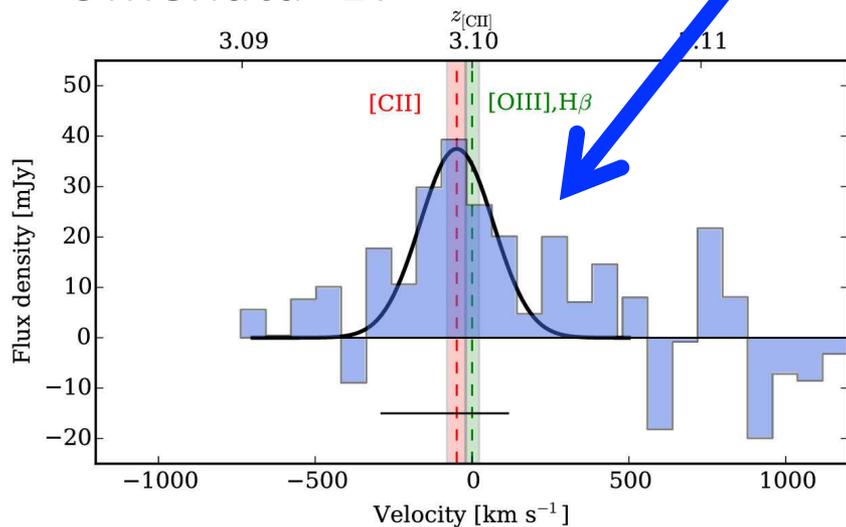
See also Ao's poster, Alexander+16, Geach+16 and Umehata+17

SSA22 LAB01

Geach+16



Umehata+17

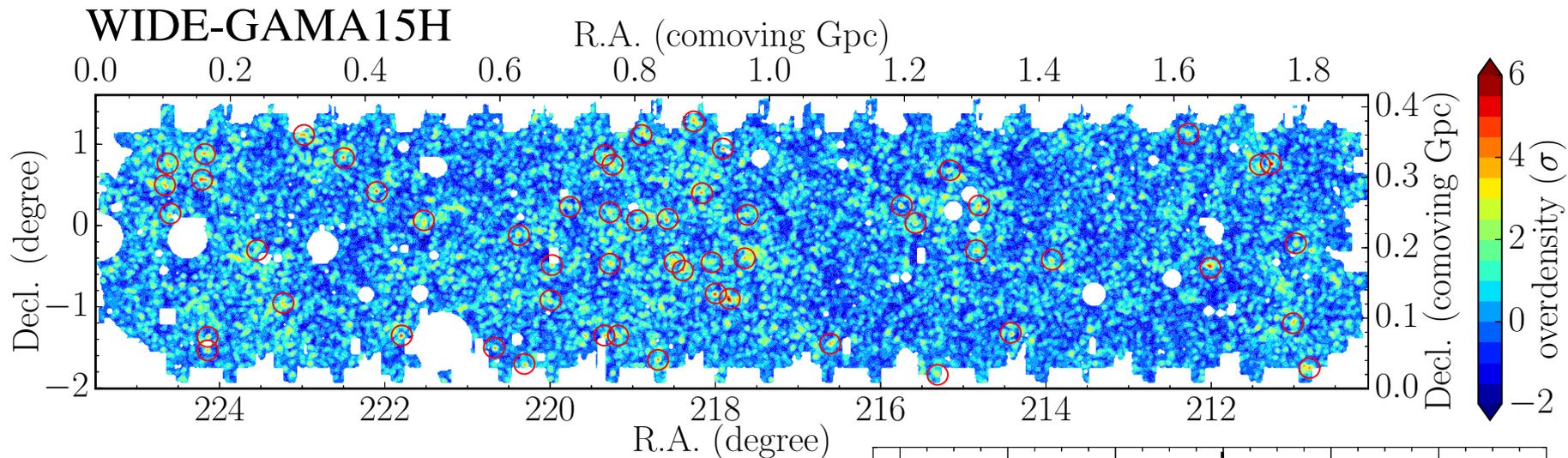


How do SMGs relate to protoclusters?

Talks by Chapman, Viera, Casey and Umehata

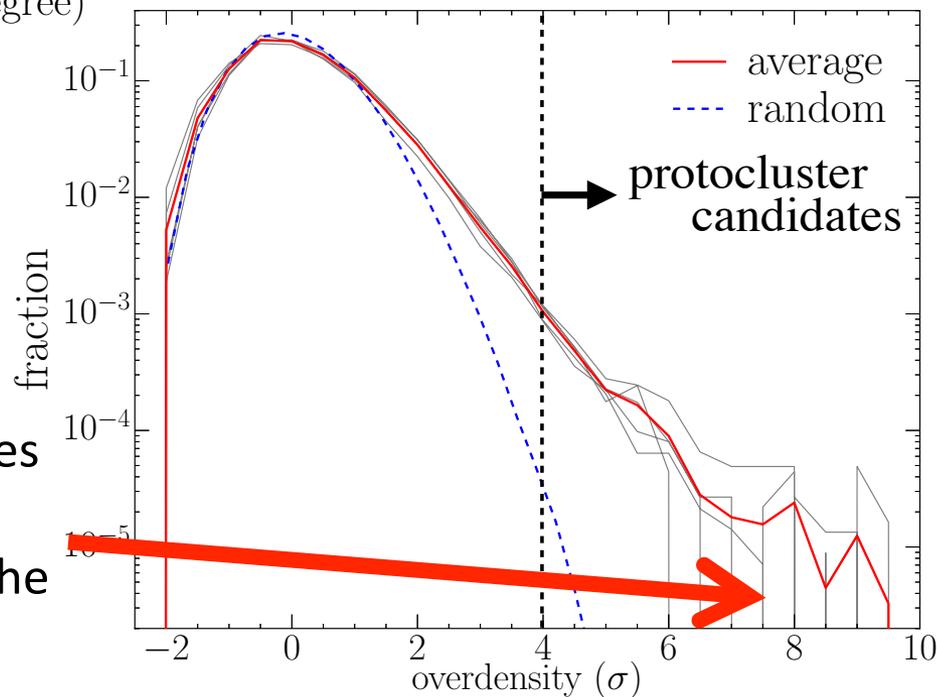
Posters by Lee, Cheng, Champagne and Dannerbauer

HSC protocluster survey (Toshikawa+)



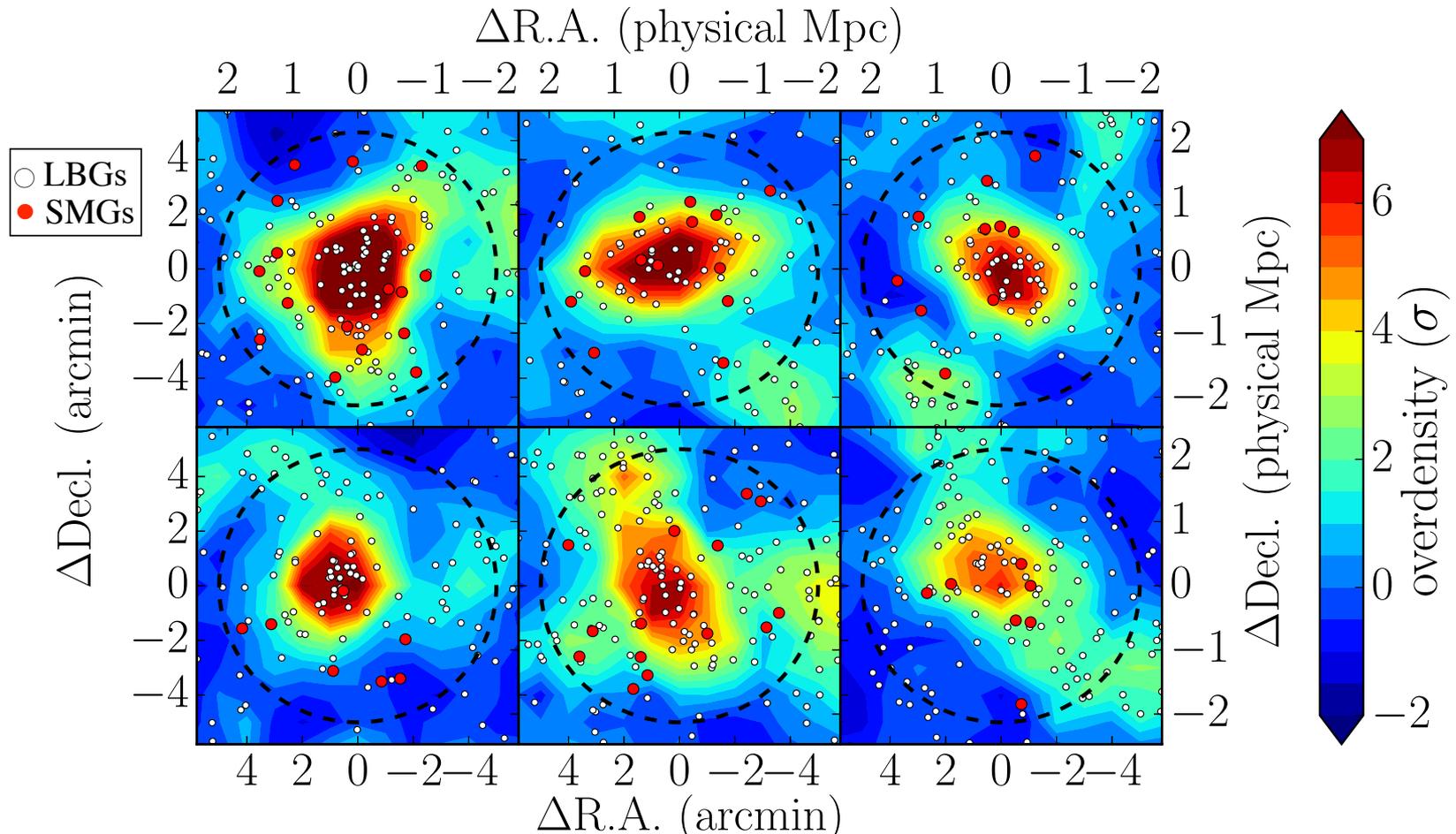
179 protocluster candidates are identified from the S16A HSC dataset ($S_{\text{eff}}=121\text{deg}^2$).

We selected 6 highest ($>7\text{-}\sigma$) overdensities at $z\sim 4$ which are expected to grow into galaxy clusters of $> 10^{14} M_{\odot}$ by $z=0$ with the probability of $> 90\%$



SCUBA-2 mapping ($z \sim 4$ HSC PCs)

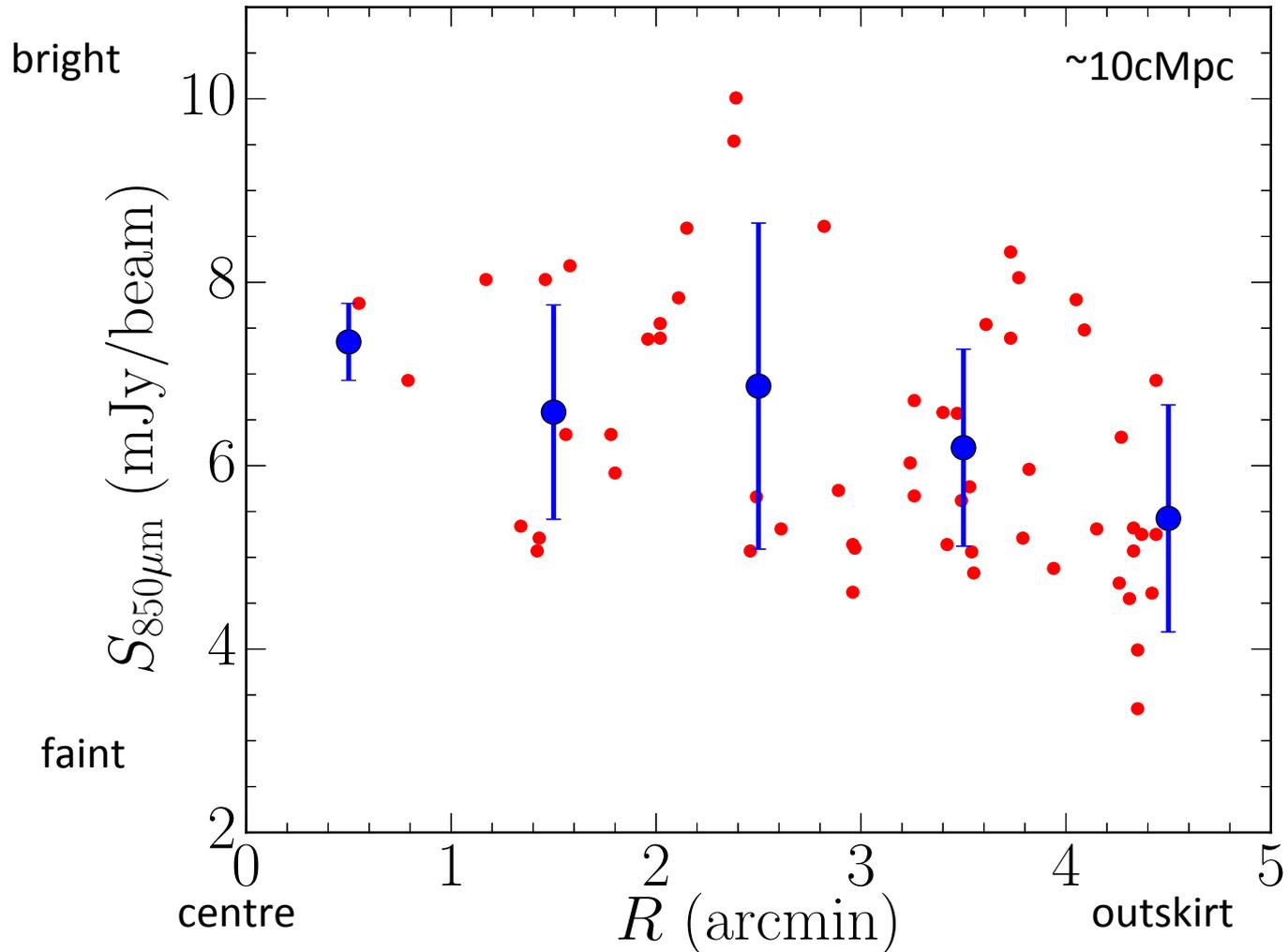
(w/ Toshikawa, Lee, Ishida, Fujimoto, Kohno, Umehata, Ao, Smail, Clements, Geach, Chapman, Blain, Edge, Gear)



ALMA follow-up of 67 SCUBA-2 sources (Toshikawa+, Cycle5)

Radial Distribution

Bright SMGs tend to lie near the centre of $z \sim 4$ protocluster?



Conclusions & Summary

- How do SMGs relate to LABs and protoclusters?
- ALMA showed that all the observed 4 giant (>100 kpc) LABs consist of single or multiple SMGs.
- SCUBA-2 showed a hint that bright SMGs are associated with UV-selected $z=4$ protoclusters.
- Future direction: How do SMGs related with Cosmic Web? -> Talk by Casey

How can we rebrand SMGs?

From Hodge's talk

- Do we need to rename SMGs?

Good examples:

Large scale structure -> Cosmic Web

Smooth gas accretion -> Cold Stream

Gaseous halo -> Circum galactic medium